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Department of Energy
Richland Field Office
P.O. Box 550
Richland, Washington 99352

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94-ERB-112

9413224.0997

Mr. Douglas R. Sherwood
Hanford Project Manager
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352

Mr. Roger F. Stanley
Hanford Project Manager
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

Dear Messrs. Sherwood and Stanley:

N SPRINGS EXPEDITED RESPONSE ACTION (ERA)

Please find enclosed the "Summary of Historical Documents Relating to N-Springs" (enclosure 1) to be included in the administrative record. This document summarizes additional historical information discovered during the public review period which ended on March 24, 1994. The studies, which covered the time frame from 1960 to 1989, pertain to hydrologic studies relating to the hydrogeology of the 100-N Area and the N Springs.

The document also includes comments on these publications regarding: channels in the aquifer, transfer of fine-grained sediments through the aquifer, groundwater and radionuclide travel time, and geology.

In addition, the U.S. Department of Energy, Richland Operations Office (RL), has included in this transmittal, an independent cost estimate (enclosure 2) on additional vertical barrier technology which received some attention during the public comment period on the N Springs proposal. As you know, during the public meeting in Hood River, Oregon, RL received an unsolicited bid proposal from a company interested in using freeze wall technology at N Springs. The grouted-interlock, sheet-pile wall technology surfaced in the Independent Technical Review of the N Springs ERA Proposal.

RL hopes that you will consider this information as you prepare the Action Description Memorandum. If you have any questions, please call Mr. Bryan L. Foley on (509) 376-7087.

Sincerely,

Patrick W. Willison
Acting Hanford Project Manager

END:BLF

cc w/o encls:
M. Lauterbach, WHC
J. Monhart, EM-442
J. Patterson, WHC
P. Valcich, WHC

cc w/encls:
B. Austin, WHC
S. Balone, EM-442
M. Harmon, EM-442
P. Innis, EPA
K. Parrett, MACTEC
P. Staats, Ecology

From: Water Resources Engineering 86910-94-010
Phone: 376-9924 H6-06
Date: April 26, 1994
Subject: SUMMARY OF HISTORICAL DOCUMENTS RELATING TO N-SPRINGS

To: P. J. Valcich H6-04

cc: K. R. Fecht H6-06
A. J. Knepp H6-06
M. J. Lauterbach H6-01
File/LB

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The following paragraphs are summaries of hydrologic studies relating to the hydrogeology of the 100-N Area and the N-Springs, as requested by you and Mr. B.L. Foley of the U.S. Department of Energy, Richland Operations Office. Documents are discussed in chronological order. Comments and clarifications are noted in square brackets. Additional comments and comparisons are presented after the summaries.

BROWN AND ROWE, 1960: 100-N AREA AQUIFER EVALUATION 0009349

The authors estimated aquifer transmissibility [transmissivity] and coefficient of storage from water level fluctuations in wells and the river. The estimated groundwater flow velocity was approximately 90 ft/d, which equates to 9 d travel time from the crib to the river. The method used was Rowe (1960), published in the Journal of Geophysical Research. [However, there was an error in this method, as pointed out by Hantush (1961), also in the Journal of Geophysical Research.]

When the river stage was low, the water table at 100-N Area was in the Ringold Formation; when high, the water table was in the glaciofluviatile sediments [Hanford formation]. A cross section based on test holes shows the Hanford/Ringold contact at 385 to 395 ft msl (lowest near the river).

Transmissibility [transmissivity] estimates ranged from 30,000 to 60,000 gpd/ft [4000 to 8000 ft^2/d]; Storage coefficient = 0.1. Using these values and an aquifer thickness of 20 ft [presumably, this thickness applied nearest the river. The aquifer was thicker in general], permeability [hydraulic conductivity] ranged from 1500 to 3000 gpd/ft^2 [200 to 400 ft/d].

Based on the above information and assuming a discharge rate of 3600 gal/min, the authors concluded the proposed 1301-N trench should be parallel to the river, 30 feet wide, 8000 feet long, and should result in no springs forming in the river bank.

BROWN, 1962: GEOLOGY UNDERLYING HANFORD REACTOR AREAS 0012814

This paper describes the geology and hydrogeology of the northern portion of the Hanford Site, based on data from wells, outcrops, and some limited geophysics.

The paper presents a contour map of the Ringold surface, which "suggests that the Ringold surface was eroded at one time by the Columbia River." Two main channels are described: (1) southwest of the 100-B Area, trending southeast along the south side of Gable Butte, and (2) between the 100-B and 100-K Areas. This second channel splits, with one fork along the north flank of Gable Mountain and the other fork trending northeast toward the 100-F Area.

The authors note that these ancient river channels affect groundwater flow. "Tracer tests have shown the groundwater to be moving at relatively high velocities through glaciofluviatile sediments deposited in channels cut into the Ringold Formation... The general locations of the channels are inferred where the groundwater contours are concave inland away from the river (p. 19).

BENSEN, ET AL., 1963: CHEMICAL AND PHYSICAL PROPERTIES OF 100 AREA SOILS 0009242

The authors presented a summary of cation exchange capacities and particle size distribution of sediments in and near the 100 Areas, not including the 100-N Area. Data are presented in an appendix. "In general the cation exchange capacity of the sediments examined increased with distance inland from the Columbia River.... Subsoils underlying the B, D, and K Areas and surroundings have an average ion exchange capacity of about 4 meq/100 g of soil. Soils in the H and F Areas have an average ion exchange capacity of about 2 meq/100 g of soil." (p.3)

BROWN, 1964: GROUND WATER TRAVEL TIME CALCULATIONS FOR THE 1301-N CRIB 0009348

[1301-N crib was not yet in operation]

The researchers used a leaking retention basin in the 100-H Area as an analogy for 100-N Area. They used an electrical analog model to calculate the shortest groundwater streamline, assuming a porosity of 30% and a permeability [hydraulic conductivity] of 2000 gal/ft^2/d [270 ft/d]. [The authors stated that this permeability was somewhat high for 100 Areas sediments].

^{131}I and ^{133}I were present in cooling water in the leaking basin; the authors used ratios of their concentrations to determine the travel time from the basin to the river in the 100-H Area. The actual travel times were 8 times longer than those calculated based on the analog model. The authors attributed the difference to the high permeability input to the model.

The authors applied the same type of streamline analysis to the 1301-N crib. The resulting minimum travel time was 12 d under low river stage. Thus the actual expected travel time was 96 d [12 d x safety factor of 8].

The authors stated "where springs issue from sedimentary deposits there is a tendency for the water to winnow the fine-grained sediments from the coarser ones to produce zones of high permeability... It is reasonable to assume that the springs which will appear at the 1301-N crib site... will not develop to the point that the permeability will be appreciably different than at the 100-H area. The calculated minimum travel time... therefore more than compensates for the possibility of an increase in permeability due to groundwater channeling and the eventual development of springs." (p. 14)

NELSON, 1964: ANALYSIS OF WASTE RELEASED BY SEEPAGE TO THE COLUMBIA RIVER FROM THE 1301-N CRIB 0035948

[1301-N crib was not yet in operation]

This paper presents methods for predicting arrival-time distribution of wastes to the river. Effects that reduce the rate of contaminant entry to the river include travel time variations due to flow geometry, decay time during slow groundwater movement, and decay time by delay due to ion exchange.

The paper expanded on Brown (1964). The analysis made conservative assumptions so there is a margin of safety of 5 to 10 times in the calculated travel times. "Therefore, a calculated travel time of 12 d, as found in this case, represents an actual travel time of 60-120 d" (p.2)

HAJEK, 1965: ADSORPTION, MIGRATION, AND DISPERSION OF STRONTIUM AND CESIUM IN AN N-AREA SOIL 0035953

The paper presents experimental and mathematical results of an investigation evaluating the potential for disposal of emergency liquid waste water to the ground [the document did not specify the identity of the proposed facility]. The objectives of the study were to determine the adsorption, elution, and diffusion characteristics of trace quantities of strontium and cesium in sediments at the site, and to estimate soil percolation.

Laboratory experiments showed that N-Area soil was more selective for cesium (Kd = 420 ml/g) than for strontium (Kd = 43 ml/g).

Migration rates were calculated based on theoretical equations and equilibrium distribution coefficients: Strontium migration rate = 1/100 of groundwater rate; Cesium migration rate = 1/1000 of groundwater rate.

CARLILE AND HAJEK, 1967: SOIL RADIONUCLIDE ADSORPTION AND PARTICULATE FILTRATION IN AN N-AREA SOIL 0035950

[related to Hajek, 1965]

The purpose of this study was to evaluate the extent of radionuclide movement, both ionic and particulate, from the 1301-N crib.

Laboratory soil column investigations with high activity cesium and strontium solutions showed breakthrough values to be appreciably higher than previous extrapolated predictions for N-area soils. This was believed to be due to colloidal or particulate migration. The authors concluded that "...any volume of waste solution of cesium and strontium sufficient to reach groundwater will exceed the required reduction in activity of 10^{-4}%." (p.5). They recommended pretreatment of the soil or waste to reduce breakthrough.

BAINARD, 1966: CHEMICAL DISPOSAL TO THE COLUMBIA RIVER BY 100-N AREA 0035949

This paper presents the results of a review of the disposal of chemicals to the river from 100-N Area, to determine if any water pollution hazards existed. The study did not address radionuclides, the 1301-N crib or N-Springs.

ELIASON, 1967, FIELD EVALUATION OF GROUND DISPOSAL OF REACTOR EFFLUENT - 1301-N CRIB 0035951

This study estimated travel time from the 1301-N crib to N-Springs by correlating peak concentrations of ^{131}I and tritium at the crib and in wells and springs. The minimum travel time was estimated to be 79 d at the point of maximum flow for tritium, and 101 d for ^{131}I. The author estimated that >70% of the effluent followed longer flow paths and thus had a longer travel time.

The maximum groundwater velocity based on a 79 d travel time is 10.8 ft/d. The author states that "this velocity does not exceed the settling velocity of fine silt particles... and transport of particles greater than this size would be unlikely" (p. 6). "With [the] high loading pressure, the calculated groundwater velocity and the large percentage of material with grain sizes >0.002 mm, it is extremely difficult to visualize any significant channeling of the sediments at the site, and no channeling has been observed during the past 2 years of crib use." (p. 7).

The paper presented estimates of the distribution of long-lived isotopes in the sediments beneath the 1301-N crib, based on laboratory tests.

Migration rates for ^{90}Sr and ^{137}Cs were predicted based on laboratory tests to be 1/100 and 1/1000 that of groundwater, respectively.

HAJEK, 1968: WASTE DISPOSAL TO THE GROUND AT 100-N 0035952

The objective of this study was to present information to aid in determining the suitability of wastewater for ground disposal in the 100-N area. The study was based on a review of the literature and unpublished data from soil-waste interaction studies at Hanford.

The author concluded that under alkaline conditions (pH > 8.2) some precipitation of strontium would occur. The precipitate would be retained in the soil by filtration. The distribution coefficient is affected by pH and competing cation concentrations.

The paper presents a statistically based regression equation that gives estimates of Kd for trace strontium in the presence of 4 competing cations. "Studies at Hanford (unpublished) have shown that in river and groundwater solutions, sodium levels as high as 500 ppm do not seriously affect strontium adsorption at pH>7." (p.10) "The calcium ion concentration should be maintained below 40 ppm ionic calcium. Other cations such as sodium, potassium, magnesium, and ammonium usually do not limit strontium retention; however, any of these ions can limit if present in high concentrations." (p.11)

TILLSON ET AL., 1968: GROUND WATER EXCHANGE WITH FLUCTUATING RIVERS 003590

This document presents information on water behavior adjacent to fluctuating rivers, concerning bank storage and river water penetration into aquifers. It evaluates storage and exchange at Hanford--total bank storage for a typical year was 2.0 x 10^9 cubic feet, of which 36% was river water.

Bank storage is the general term for river water stored in an aquifer during flood stage. This paper defines it more broadly as "water, both river and ground, that is stored in a zone above base flow stage" (i.e., a "wedge" of water between the initial and high water table).

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The study used the 300 Area as an example. Temperature was used to distinguish river water from groundwater in the aquifer. River water penetrated about 2000 feet from the river bank. A map of the entire Hanford Site is presented, showing the extent of river water penetration based on temperature changes and water table fluctuations. The region including the 100-N Area is shown with a very narrow zone of river water infiltration.

CREWS AND TILLSON, 1969: ANALYSIS OF TRAVEL TIME OF I-131 FROM THE 1301-N CRIB TO THE COLUMBIA RIVER DURING JULY 1969 0350

The authors correlated sudden changes in radionuclide concentrations in crib effluent (following fuel element failure) to peaks in radionuclides at springs and wells. The estimated minimum travel time was 9±1 d for ^{131}I. Peak concentrations were observed at 15±1 d.

Samples were taken from four wells and four springs at 12- to 24-hr intervals. The authors stated that travel times "could easily be three to four days less [than nine days] depending on the status of the river stage" (p. 5).

The authors speculated that "Channels or open pathways apparently have developed between the 1301-N crib and the Columbia River bank since the inception of crib operation in 1964." (p. 2) "Some field evidence can be seen that indicates the river-bank springs in 100-N area have developed along solution channels and may not accurately represent flow lines along the saturated groundwater potential surface." (p. 5)

RADIONUCLIDE MIGRATION IN GROUNDWATER

ROBERTSON, ET AL., 1984: ANNUAL PROGRESS REPORT FOR 1982 0019263
FRUCHTER, ET AL., 1984: ANNUAL PROGRESS REPORT FOR 1983 0035955
FRUCHTER, ET AL., 1985: FINAL REPORT 0035956

The objective of this study, conducted by PNL, was to define radionuclide migration at the 1301-N site. The study was divided into four areas: (1) determine the physicochemical speciation and transport of radionuclides in the field; (2) characterize organic species in the water and their potential effects on radionuclide migration; (3) conduct a laboratory study of the adsorption and desorption of neptunium (Np) on soils from the site; and (4) construct a preliminary geochemical model of the behavior of some of the radionuclides.

3 wells were installed near the 1301-N crib for the study. Soil cores contained very low concentrations of only those radionuclides that existed in soluble, mobile forms (the same as seen in N-Springs). The maximum concentrations were observed in a narrow band, approximately 8 m in thickness.

The investigators sampled trench water and groundwater from the well closest to the crib (well 1). Particulate radionuclides in well 1 were very low. It was not certain whether the colloids got to the well by transport, or if the radionuclides had migrated in solution and were then sorbed onto natural soil colloids. The soluble fraction constituted 90% or more of total activity at well 1.

Most of the radionuclides in the influent water were removed in the disposal basin and trench by either precipitation or adsorption. Mobile forms were anionic and nonionic charge forms. ^{90}Sr was the only radionuclide to migrate to the springs exclusively in a cationic form. ^{90}Sr in dissolved cationic form was predominant in trench, well, and spring water samples. Ion exchange was postulated to be the principal mechanism of ^{90}Sr adsorption to soils. No particulate ^{90}Sr was observed in well or spring water. Observed ^{90}Sr behavior appeared consistent with predicted migration based on equilibrium distribution coefficients. Using a Kd value of 123 ±13 in the retardation equation, the calculated ^{90}Sr travel time was about 10 yr from the trench to N springs, "which appears to be in agreement with field observations."

The estimated in situ Kd values and the velocity of the radionuclide front were in accordance with the observed behavior of ^{60}Co, ^{90}Sr, ^{106}Ru, ^{125}Sb, and ^{137}Cs in groundwater. The in situ Kd values for Co, Ru, and Sb isotopes were found to be significantly lower than published Kd values based on laboratory measurements. Complexes with natural and manmade organic compound in groundwater were implicated in the increased mobility of these radionuclides, especially ^{60}Co.

The isotopes of Sb, Ru, and Co were found to be clearly associated with the higher molecular weight organics, especially humic and fulvic acids. This strongly supported the concept that the anionic form of these isotopes may result in part from organic complexation, especially in the case of ^{60}Co.

Neptunium adsorption data on these low organic carbon soils were consistent with the hypothesis that amorphous iron oxide fractions of the amorphous oxides in the soil determine the adsorption behavior of the neptunyl oxy cation, NpO_2^+.

Geochemical modeling indicated that the mobile species of the radionuclides are the anionic and nonionic oxy- and hydroxy complexes, although organic complexes may be important mobile species for iron, zinc, and cobalt. Those radionuclides that occur in groundwater predominantly as the uncomplexed cation (e.g. Cs, Ce, Mn) appeared to be most retarded. Groundwaters were calculated to be in equilibrium with several solid phases that could be important for controlling the concentrations of trace elements and radionuclides: calcite, aluminosilicates, and ferrihydrite.

PROBASCO, ET AL., 1986: CHARACTERIZATION OF RADIONUCLIDE CONCENTRATIONS OF THE N-SPRINGS ALONG THE COLUMBIA RIVER SHORELINE 0035959

Seep wells and seep spots were sampled during low river stage and radionuclide concentrations were compared to those at the composite sampling well, N-8T. Most seeps had lower concentrations than N-8T. Three seeps had higher concentrations of some radionuclides. "Travel times from trench sections may be short in this area possibly due to underground channeling..." (p.3).

The report concluded that well N-8T adequately and conservatively represented N-Springs discharge.

ROBERTSON, ET AL., 1989: DEMONSTRATION OF PERFORMANCE MODELING OF A LOW-LEVEL WASTE SHALLOW-LAND BURIAL SITE 0035958

The report presents a comparison of predictive radionuclide transport modeling and field observations at a low-level radionuclide disposal area in Canada. Researchers matched model results to observed distribution of radionuclides, primarily ^{90}Sr and ^{137}Cs.

The modelers used a time-variable series of retardation factors for ^{90}Sr to account for changing conditions. Retardation was initially low because the effluent was acidic and the trench was lined in lime (i.e., many competing cations), and concentrations of ammonium and nitrate were high. With time, the acid was neutralized and ions were diluted, resulting in higher retardation of ^{90}Sr. Results matched the observed distribution fairly well.

[The site was similar to the 1301-N site in several respects: geology of glacio-fluvial sediments above low-permeability bedrock; liquid waste disposal including ^{90}Sr and ^{137}Cs. Differences from the 1301-N site included: mineralogy in aquifer sediments, hydraulic properties of sediments; factors affecting retardation of radionuclides.]

UNC ENVIRONMENTAL SURVEILLANCE REPORTS FOR THE 100 AREAS

POPPE, 1979: DESCRIPTION OF PROGRAM 0035889
GREAGER. 1980: FY 1980 0019540
GREAGER, 1981: FY 1981 0035946
GREAGER, 1982: FY 1982 0035945
GREAGER, 1983: FY 1983 00359--
GREAGER, 1984: FY 1984 0035947
JACQUES, 1987: FY 1986 00103--

Poppe (1979) describes the environmental surveillance program being instated at the 100-N Area. The remaining reports were prepared annually and presented the results of air, groundwater, vegetation, surface soil, and crib sediment samples collected in the 100-N Area, and for some media, in other locations in the 100 Areas.

Most of the reports list average and maximum radionuclides detected in 100-N Area groundwater. ^{90}Sr data are not included. The documents mention N-Springs sampling, but results are not presented.

COMMENTS

Channels in the Aquifer

There are two different uses of the term "channels" in the documents summarized above. Brown (1962) discusses old river channels in the 100 Areas. These are large features that can be seen in geologic maps and appear to be reflected in water table maps.

Brown (1964) discusses the possibility of groundwater developing channels in the aquifer as fine-grained sediments are winnowed out near springs. Crews and Tillson (1969) also say channels "apparently have developed" since the crib was in use, and that there is "some field evidence" for these solution channels (no specific examples are cited).

However, Eliason (1967) states that "no channeling has been observed during the past 2 years of crib use," and that with calculated groundwater velocities, it is unlikely that fine materials would be winnowed out to form channels.

Transport of Fine-Grained Sediments through the Aquifer

The documents present conflicting views on the transport of colloids or other fine particles in the aquifer. Carlile and Hajek (1967) believed transport of radionuclides in their laboratory tests was due to colloid migration. Crews and Tillson (1969) attributed channel development to the removal of fine-grained sediments from the aquifer. However, Eliason (1967) believed particle transport was unlikely, given the existing groundwater velocities, and other investigators (Robertson, et al., 1984, Fruchter, et al., 1984, 1985) found virtually no particulate radionuclides in groundwater samples.

Groundwater and Radionuclide Travel Times

Brown (1964) and Nelson (1964) predicted travel times from the 1301-N crib to N-Springs before the crib was operational. Their predicted travel time of 12 days included a conservative safety factor; actual expected travel time was 96 days.

Eliason (1967) correlated peaks in tritium and ^{131}I and estimated that it took a minimum of 79 days for tritium to move from the crib to the river, and 101 days for ^{131}I. Crews and Tillson (1969) also correlated peaks in ^{131}I, and estimated a minimum travel time of 9 days. Tritium travels at the same rate as groundwater; ^{131}I travels only slightly slower than groundwater. The peak correlation studies were not controlled tracer tests.

The travel time for ^{90}Sr would be approximately 100 times that of tritium or ^{131}I (Eliason, 1967). Fruchter, et al. (1984) states that ^{90}Sr travel time from the crib to the springs was calculated to be 10 yr, "which appears to be in agreement with field observations." However, no reference was given for the first detection of ^{90}Sr in springs. Note that this estimate of travel time is much greater than what would be expected for ^{90}Sr based on the peak correlation studies.

The travel times discussed here are for the first arrival of contaminated groundwater. Most of the effluent from the crib followed longer paths to the river and arrived later (Eliason, 1967). The authors of some studies attributed the rapid travel to channels in the aquifer.

Current travel times would be expected to be longer because: (1) the hydraulic gradient between the crib and the river is an order of magnitude less than it was when 1301-N was active, (2) the water table when 1301-N was active was in the Hanford sediments, which are more permeable than the Ringold, (3) if channels exist in the aquifer as postulated by some researchers, they would be concentrated in the Hanford sediments, above current water table.

Geology

Descriptions of 100-N Area geology are fairly consistent between the older documents and recent documents, although different terminology was used. Recent interpretations give more details in Ringold stratigraphy. The older documents refer to the topography around the 100-N Area as "kame and kettle," while the more recent interpretation is that the hills are giant ripple marks.

Please call me on 376-9924 if you require any more information.

Mary J Hartman

M. J. Hartman
Senior Scientist

dds

N-SPRINGS ERA ALTERNATIVES

Alternative: Freeze Wall

Capitol Cost: (installed)

Freeze wall, subcontractor installed	$4,000,000
Testing (including engineering)	$50,000
Engineering @ 10%	$400,000
Project Management @ 11%	$440,000
SUB-TOTAL:	$4,890,000
Contingency @ 30%	$1,467,000
TOTAL Capital Cost	**$6,357,000**

O & M Cost: (annual)

Operating Labor (2.5 FTE)	$375,000
Maintenance (1.5 FTE)	$250,000
Electric Power (8 Million KwH @ $0.035)	$280,000
Annual O & M Cost	$905,000
Present Worth, Annaul O&M 10 Yrs @ 10%	**$5,560,000**
PRESENT WORTH	**$11,917,000**

NOTE:

freezeWALL, Inc., actually quoted a higher cost for installation of pipes. In the Alternate 3, Vertical Barrier comparison, only one year of O&M cost was included (@ $459,000). If the Present Worth of the cost would have been added, it would have added $2,820,000 to the cost, giving a Total Present Worth cost of $9,853,400, not $7,492,400.

HNFD: N-Springs Freeze Wall
Rough budget estimate for a
Freeze wall, 2,800 LF x 50' D

Designed By:
Estimated By: Clendenon

Prepared By: USACE NPW Cost Engineering

Preparation Date: 04/24/94
Effective Date of Pricing: 03/22/94
Est Construction Time: 180 Days

This estimate is an order of magnitude budget estimate for installation of a freeze wall along the river shore at the N-Reactor site. This wall is assumed 2,800 LF x 50' deep, the freeze wall being about 25' wide when fully formed. 4" D vibratory driven steel pipe piles are assumed used in the freeze wall system, a 2" D pvc supply pipe being inserted into each of about 930 holes, 6' o.c. and 15' apart. The holes are connected with a pipe manifold system to initially six (6) refrigeration plants for forming the freeze wall, then to three (3) refrigeration plants for maintaining the wall in its fozen state. Costs for installation of the freeze wall system were supplied by freezeWall, Inc., Rockaway, NJ.

For comparing with other alternatives will use:

Engineering @ 10%
Project Management @ 11%

Contingency @ 30%

O & M Cost: 10 years @ 10% discount rate == 6.14457 factor x Annual cost

SUMMARY REPORTS — SUMMARY PAGE

DETAILED ESTIMATE — DETAIL PAGE

BACKUP REPORTS — BACKUP PAGE

* * * END TABLE OF CONTENTS * * *

	QUANTITY UOM	CONTRACT	Engr	ProjMngt	CONTINGN	TOTAL COST	UNIT COST	NOTES
1 Freeze Wall, 50' D, 25' W		3,996,450	399,640	483,570	1,463,900	6,343,560		
TOTAL HNFD: N-Springs Freeze Wall	140000.00 SF	3,996,450	399,640	483,570	1,463,900	6,343,560	45.31	

	QUANTITY UOM	CONTRACT	Engr	ProjMngt	CONTINGN	TOTAL COST	UNIT COST	NOTES
1 Freeze Wall, 50' D, 25' W								
1-01 Mob, DeMob, & Prepwork		50,000	5,000	6,050	18,310	79,360		
1-02 Site Work		3,946,450	394,650	477,520	1,445,590	6,264,200		
TOTAL Freeze Wall, 50' D, 25' W		3,996,450	399,640	483,570	1,463,900	6,343,560		
TOTAL HNFD: N-Springs Freeze Wall	140000.00 SF	3,996,450	399,640	483,570	1,463,900	6,343,560	45.31	

	QUANTITY UOM	DIRECT	FOOH	HOOH	PROF	BOND	B&O TAX	TOTAL COST	UNIT COST
1 Freeze Wall, 50' D, 25' W		3,610,920	178,640	68,480	115,040	7,770	15,610	3,996,450	
TOTAL HNFD: N-Springs Freeze Wall	140000.00 SF	3,610,920	178,640	68,480	115,040	7,770	15,610	3,996,450	28.55

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	QUANTITY UOM	DIRECT	FOOH	HOOH	PROF	BOND	B&O TAX	TOTAL COST	UNIT COST
1 Freeze Wall, 50' D, 25' W									
1-01 Mob, DeMob, & Prepwork		37,770	5,670	2,170	3,650	250	500	50,000	
1-02 Site Work		3,573,150	172,970	66,310	111,390	7,520	15,110	3,946,450	
TOTAL Freeze Wall, 50' D, 25' W		3,610,920	178,640	68,480	115,040	7,770	15,610	3,996,450	
TOTAL HNFD: N-Springs Freeze Wall	140000.00 SF	3,610,920	178,640	68,480	115,040	7,770	15,610	3,996,450	28.55

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	DIRECT	FOOH	HOOH	PROF	BOND	B&O TAX	TOTAL COST	UNIT COST
AA 50' Deep, General Contractor								
PD Pile Driving Subcontractor	924,150	92,410	40,660	84,580	0	0	1,141,800	
Subtotal Subcontract Work	924,150	92,410	40,660	84,580	0	0	1,141,800	
Indirect on Subcontracts	1,141,800	171,270	65,650	110,300	7,450	14,960	1,511,440	
Indirect on Own Work	49,110	7,370	2,820	4,740	320	640	65,010	
AA 50' Deep, General Contractor	1,190,920	178,640	68,480	115,040	7,770	15,610	1,576,450	
AB No Mark Items	2,420,000	0	0	0	0	0	2,420,000	

1-01. Mob, DeMob, & Prepwork	QUANTY UOM	CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
1. Freeze Wall, 50' D, 25' W 2,800 LF, 50' deep, Freeze wall, placed using 4" steel pipe piles at 6' o.c. and 15' apart creating a 25' wide freeze zone wall. 1-01. Mob, DeMob, & Prepwork										
1-01 01. Mobilization This covers equipment mobiliztion.										
CIV AA <01505 1401 > Mob, Crane, 25-50 Ton, Mech, Trk Mtd, 100' boom, 100-mi Rad	5.00 EA	N/A	0.00	0.00 0	0.00 0	625.00 3,125	0.00 0	0.00 0	625.00 3,125	625.00
CIV AA <01505 8532 > Mob, Pile Extractor, 40 Ton, Line Pull, 100-mi Rad	2.00 EA	N/A	0.00	0.00 0	0.00 0	375.00 750	0.00 0	0.00 0	375.00 750	375.00
CIV AA <01505 8534 > Mob, Pile Leads, 10"x37", 60' L, 100-mi Rad	10.00 EA	N/A	0.00	0.00 0	0.00 0	350.00 3,500	0.00 0	0.00 0	350.00 3,500	350.00
CIV AA <01505 8561 > Mob, Pile Hammer, Vib, 40 Ton Max Driving Force, 100-mi Rad	5.00 EA	N/A	0.00	0.00 0	0.00 0	175.00 875	0.00 0	0.00 0	175.00 875	175.00
CIV AA <01505 8101 > Mob, Air Comp, 100- 250 CFM, Quiet, Portable, 100-mi Rad	5.00 EA	N/A	0.00	0.00 0	0.00 0	75.00 375	0.00 0	0.00 0	75.00 375	75.00
CIV AA <01505 5202 > Mob, Motor Grader, 126-150 HP, Art. Fr, Pwr Shift, 100-mi Rad	1.00 EA	N/A	0.00	0.00 0	0.00 0	475.00 475	0.00 0	0.00 0	475.00 475	475.00
CIV AA <01505 6115 > Mob, Dozer, Crawler, 176-225 HP w/blade, Incl Setup, 100-mi Rad	1.00 EA	N/A	0.00	0.00 0	0.00 0	700.00 700	0.00 0	0.00 0	700.00 700	700.00
CIV AA <01505 7114 > Mob, Truck, 10,000-30,000 GVW, w/ 8'x 16' Flat Bed, 100-mi Rad	5.00 EA	N/A	0.00	0.00 0	0.00 0	85.00 425	0.00 0	0.00 0	85.00 425	85.00
CIV AA <01505 8516 > Mob, Misc Small Equip, < 2,750# Haul w/small flatbed, 100-mi Rad	10.00 EA	N/A	0.00	0.00 0	0.00 0	75.00 750	0.00 0	0.00 0	75.00 750	75.00
USR AA < > Mobilization of Field Offices	2.00 EA		0.00	0.00 0	250.00 500	200.00 400	53.90 108	0.00 0	503.90 1,008	503.90
TOTAL Mobilization				0	500	11,375	108	0	11,983	
1-01 02. Prep Work: Surveying & Allowance										
CIV AA <01330 1142 > Survey Party, 3-Man & Suburban Vehicle	10.00 DAY	USURB	0.13	24.00 240	424.64 4,246	62.13 621	0.00 0	0.00 0	486.77 4,868	486.77
CIV AA <01330 1144 > Surveying Data & Drafting	40.00 HR	UFLDA	1.00	1.25 50	21.18 847	0.35 14	0.00 0	0.00 0	21.53 861	21.53
USR AA <01310 > Prepwork/Submittals Allowance	240.00 HR		0.00	0.00 0	30.00 7,200	2.50 600	1.08 259	0.00 0	33.58 8,059	33.58

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1-01. Mob, DeMob, & Prepwork	QUANTY UOM CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
TOTAL Prep Work: Surveying & Allowance			290	12,294	1,235	259	0	13,788	
1-01 03. DeMobilization									
Assume Demob at 100% of Mob.									
TOTAL DeMobilization			0	0	12,000	0	0	12,000	
TOTAL Mob, DeMob, & Prepwork			290	12,794	24,610	367	0	37,770	

9413224.1019

1-02. Site Work	QUANTY UOM CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
1-02. Site Work									
1-02 01. Site Prep - Work Platform									
Assume a work platform will need to be prepared. Platform will be constructed using a D-7 dozer, G-12 grader, and water truck (6K gal). Assume about 15'-20' wide platform, no new fill needed, 5 days to prepare. There is a existing roadway which could be used or widened, but assume above work will still be needed.									
L USR AA <02210 1005 > Rough Grade Small Area w/Dozer			2.00	54.75	62.82	0.00	0.00	117.57	
Cat D-7, 215 HP. Allow 5 days for dozer to rough grade platform for pile driving and grouting work.	40.00 HR CODTH	1.00	80	2,190	2,513	0	0	4,703	117.57
L USR AA <02210 2001 > Grade platform			8.00	219.00	111.25	0.00	0.00	330.25	
	6.00 MSY COFGA	0.25	48	1,314	668	0	0	1,982	330.25
USR AA <02223 1001 > Compaction/Dust control Water,			1.75	49.33	67.15	0.00	0.00	116.47	
from river	40.00 HR COFWK	1.00	70	1,973	2,686	0	0	4,659	116.47
TOTAL Site Prep - Work Platform	2800.00 LF		198	5,477	5,866	0	0	11,343	4.05
1-02 02. Steel pipe pile installation									
This covers cost for a 930 EA + 56 EA + extra allowance, 4" D x 55 VLF steel pipe pile, assume using thick wall pipe, placed by vibratory driver. By placing wall close to river, it is assumed the wall will miss the large cobble/boulder layer associated with the Hanford formation. For this number of piles, 4-5 pile driver units would be needed in order to complete in a timely matter (1-2 months). Assume a Pile Driver Subcontractor will be used to place pipe piles.									
B USR PD <02316 2001 > 4" D, Non-Filled Pipe Piles			0.27	7.34	3.42	4.58	0.00	15.33	
Steel, thick walled. 930 ea @ 55 vlf = 51,150 vlf add 5% for extras = 2,550 vlf add 56 @ 55 vlf = 3,080 vlf (for monitoring) ----------- Total: 56,780 vlf USE: 56,800 vlf	56800 VLF CPIDC	30.00	15,149	514,766	239,790	321,518	0	1,076,074	18.94
B MIL PD <02316 3201 > 4" D, Pipe Pile Point			1.25	39.15	1.72	10.78	0.00	51.65	
Standard, Steel 930 ea points + 56 ea (monitor) + 44 ea for extras == 1,030 ea	1030.00 EA SIWWA	1.00	1,288	49,822	2,190	13,718	0	65,730	63.82
TOTAL Steel pipe pile installation	51150 VLF		16,436	564,588	241,979	335,237	0	1,141,804	22.32

1-02. Site Work	QUANTY UOM	CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
1-02 03. Permanent Equipment, 3 plants Permanent Equipment costs includes: 3 plants, data monitoring system, and refrigeration material (Freon/ ammonia; oil; Ca Cl2) Quote from: freezeWALL, Inc., Bernd Braun, Rockway, NJ (4/22/94)										
TOTAL Permanent Equipment, 3 plants				0	0	1,100,000	0	0	1,100,000	
1-02 04. Install System w/ Mob Install System w/ Mob cost includes: Surface piping material, labor & supervision (40% labor & Superv. and 60% materials and misc.) Quote from: freezeWALL, Inc., Bernd Braun (4/22/94)										
TOTAL Install System w/ Mob				0	370,000	0	550,000	0	920,000	
1-02 05. Form freeze wall Form freeze wall cost includes: 3.6 million KwHrs @ 0.05/KwHr, plus labor, supervision, and equipment (using 6 refrigeration plants to form freeze wall, about 3 month period) Quote from: freezeWALL, Inc., Bernd Braun (4/22/94)										
TOTAL Form freeze wall				0	150,000	20,000	50,000	180,000	400,000	
TOTAL Site Work				16,634	1,090,065	1,367,846	935,237	180,000	3,573,147	
TOTAL Freeze Wall, 50' D, 25' W				16,924	1,102,859	1,392,456	935,603	180,000	3,610,918	
TOTAL HNFD: N-Springs Freeze Wall	140000 SF			16,924	1,102,859	1,392,456	935,603	180,000	3,610,918	25.79

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Sun 24 Apr 1994
Eff. Date 03/22/94

U.S. Army Corps of Engineers - D.O. 94 - Final
PROJECT NSFRZW: HNFD: N-Springs Freeze Wall - Rough budget estimate for a
Budget estimate for freeze wall, N-springs
** CREW BACKUP **

TIME 09:55:26

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	CODTH	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp+Laborer			PROD = 100%			CREW HOURS =		40
MIL	B-LABORER L	Laborer (Semi-Skilled)	1.00	HR	25.64	1.00	25.64			25.64
MIL	B-EQOPRMEDF	Eq Oper, Medium	1.00	HR	29.11	1.00	29.11			29.11
MIL	T10CA013 E	BLADE, UNIVERSAL,HYDR,FOR D7	1.00	HR	5.72			1.00	5.72	5.72
MIL	T15CA013 E	DOZER,CWLR,D-7H,PS,(ADD BLADE)	1.00	HR	57.10			1.00	57.10	57.10
	TOTAL					2.00	54.75	2.00	62.82	117.57

0 0 3,996,450 28.55

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	COFGA	1 B-eqoprmed + 1 Grader, Cat 12g, 135 Hp			PROD = 100%			CREW HOURS =		24
MIL	B-LABORER L	Laborer (Semi-Skilled)	1.00	HR	25.64	1.00	25.64			25.64
MIL	B-EQOPRMEDF	Eq Oper, Medium	1.00	HR	29.11	1.00	29.11			29.11
MIL	G15CA003 E	GRADER,MOTOR,CAT12-G, ARTIC	1.00	HR	27.81			1.00	27.81	27.81
	TOTAL					2.00	54.75	1.00	27.81	82.56
	COFWK	1 B-trkdvrhvl+ 1 Water Wagon,6000 Gal + 6" Pump			PROD = 100%			CREW HOURS =		40
MIL	B-EQOPRLT F	Eq Oper, Light	0.25	HR	28.18	0.25	7.05			7.05
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	28.44	1.00	28.44			28.44
MIL	B-EQOPRLT L	Eq Oper, Light	0.50	HR	27.68	0.50	13.84			13.84
MIL	P55GR004 E	PUMP,WATER,SUB,6",1950GPM/40'HD	1.00	HR	5.68			1.00	5.68	5.68
MIL	T60KI002 E	TRK,WTR,OFF-HWY, 6000GAL,CAT621	1.00	HR	61.46			1.00	61.46	61.46
	TOTAL					1.75	49.33	2.00	67.15	116.47
	CPIDC	5 B-piledrvr + 1 SingleAction PileHammr/40TCrane			PROD = 100%			CREW HOURS =		1893
MIL	A15XX014 E	AIR COMPR, 900 CFM, 100 PSI	1.00	HR	24.17			1.00	24.17	24.17
MIL	B-EQOPRCRNL	Eq Oper, Crane/Shovl	2.00	HR	29.37	2.00	58.74			58.74
MIL	B-EQOPROILL	Eq Oper, Oilers	1.00	HR	26.68	1.00	26.68			26.68
MIL	B-PILEDRVRF	Pile Drivers	1.00	HR	29.66	1.00	29.66			29.66
MIL	B-PILEDRVRA	Pile Drivers	2.00	HR	23.33	2.00	46.66			46.66
MIL	B-PILEDRVRL	Pile Drivers	2.00	HR	29.16	2.00	58.32			58.32
MIL	C80PH004 E	CRANE,HYD,TRK MTD,40T W/106'BOO	1.00	HR	51.28			1.00	51.28	51.28
MIL	P10XX002 E	PILE LEADS, 8"X26", 60' LENGTH	1.00	HR	6.26			1.00	6.26	6.26
MIL	XMIXX020 E	Small Tools	0.90	HR	1.39			0.90	1.25	1.25
MIL	P25VU002 E	PILE HAMR,SNG,19500FT-#,ADD COM	1.00	HR	15.43			1.00	15.43	15.43
MIL	A20XX007 E	AIR HOSE, 3.0", 50', HARDROCK	2.00	HR	2.06			2.00	4.12	4.12
	TOTAL					8.00	220.06	6.90	102.51	322.56
	SIWWA	1 B-welders + 1 Electrical Welding Machine			PROD = 100%			CREW HOURS =		1030
MIL	B-WELDERS L	Welders, Struct Steel	1.00	HR	31.22	1.00	31.22			31.22
MIL	B-WELDERS F	Welders, Struct Steel	0.25	HR	31.72	0.25	7.93			7.93
MIL	XMIXX020 E	Small Tools	0.21	HR	1.39			0.21	0.29	0.29
MIL	W35XX009 E	ELEC DRIVE,WELDER,300 AMP,SKID	1.00	HR	1.43			1.00	1.43	1.43
	TOTAL					1.25	39.15	1.21	1.72	40.87

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	LABOR HOURS	LABOR COST	EQUIP HOURS	EQUIP COST	TOTAL COST
	UFLDA	Field Draftsman			PROD =	100%		CREW HOURS =		40
FOP *	FC-FLDRT	L Field Draftsman	1.00	HR	15.00	1.00	15.00			15.00
FOP *	FC-FLDER	F Field Engineer	0.25	HR	24.73	0.25	6.18			6.18
MIL *	XMIXX020	E Small Tools	0.25	HR	1.39			0.25	0.35	0.35
	TOTAL					1.25	21.18	0.25	0.35	21.53
	USURB	3 FC-suryr + 4x4 Suburban + Small Tools			PROD =	100%		CREW HOURS =		80
FOP *	FC-SURYC	L Surveyor, Chief	1.00	DAY	147.68	8.00	147.68			147.68
FOP *	FC-SURYR	L Surveyor	2.00	DAY	138.48	16.00	276.96			276.96
MIL *	XMIXX020	E Small Tools	1.00	DAY	11.12			8.00	11.12	11.12
MIL *	T50GM005	E TRK,HWY,4X4 SUBURBAN, 8600 GVW	0.75	DAY	68.01			6.00	51.01	51.01
	TOTAL					24.00	424.64	14.00	62.13	486.77

SRC	LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL	B-EQOPRCRN	Equip. Operators, Crane/Shovel	29.37	0.0%	0.0%	0.00	0.00	29.37	HR	03/15/94	21.20	3787
MIL	B-EQOPRLT	Equip. Operators, Light	27.68	0.0%	0.0%	0.00	0.00	27.68	HR	03/15/94	17.02	30
MIL	B-EQOPRMED	Equip. Operators, Medium	28.61	0.0%	0.0%	0.00	0.00	28.61	HR	03/15/94	17.15	64
MIL	B-EQOPROIL	Equip. Operators, Oilers	26.68	0.0%	0.0%	0.00	0.00	26.68	HR	03/15/94	11.00	1893
MIL	B-LABORER	Laborers, (Semi-Skilled)	25.64	0.0%	0.0%	0.00	0.00	25.64	HR	03/15/94	12.86	64
MIL	B-PILEDRVR	Pile Drivers	29.16	0.0%	0.0%	0.00	0.00	29.16	HR	03/15/94	23.05	9467
MIL	B-TRKDVRHV	Truck Drivers, Heavy	28.44	0.0%	0.0%	0.00	0.00	28.44	HR	03/15/94	10.49	40
MIL	B-WELDERS	Welders, Structural Steel	31.22	0.0%	0.0%	0.00	0.00	31.22	HR	03/15/94	24.06	1288
FOP	FC-FLDER	Field Engineers	24.23	0.0%	0.0%	0.00	0.00	24.23	HR	05/01/92	24.23	10
FOP	FC-FLDRT	Field Draftsmen	15.00	0.0%	0.0%	0.00	0.00	15.00	HR	05/01/92	15.00	40
FOP	FC-SURYC	Surveyors, Chief	18.46	0.0%	0.0%	0.00	0.00	18.46	HR	05/01/92	18.46	80
FOP	FC-SURYR	Surveyors	17.31	0.0%	0.0%	0.00	0.00	17.31	HR	05/01/92	17.31	160

SRC	EQUIP ID	DESCRIPTION	DEPR	CAPT	FUEL	FOG	EQ REP	TR WR	TR REP	TOTAL	UOM	** TOTAL ** HOURS
MIL	A15XX014	AIR COMPR, 900 CFM, 100 PSI	5.57	2.27	7.68	2.1	6.29	0.19	0.03	24.17	HR	1893
MIL	A20XX007	AIR HOSE, 3", 50',HARDROCK	0.71	0.09			1.26			2.06	HR	3787
MIL	C80PH004	CRANE,HYD,TRK MTD,40T W/106'BOOM	17.04	8.72	6.64	1.7	15.98	1.02	0.15	51.28	HR	1893
MIL	G15CA003	GRADER,MOTOR,CAT12-G, ARTIC	8.89	4.25	3.65	1.2	9.10	0.58	0.09	27.81	HR	24
MIL	P10XX002	PILE LEADS, 8"X26", 60' LENGTH	1.58	0.49		2.0	2.19			6.26	HR	1893
MIL	P25VU002	PILE HAMR,SNG,19500FT-#,ADD COMP	4.90	1.53		0.5	8.50			15.43	HR	1893
MIL	P55GR004	PUMP,WATER,SUB,6",1950GPM/40'HD	0.95	0.38	2.43	1.0	0.84			5.68	HR	40
MIL	T10CA013	BLADE, UNIVERSAL,HYDR,FOR D7	2.31	0.82		0.0	2.51			5.72	HR	40
MIL	T15CA013	DOZER,CWLR,D-7H,PS,(ADD BLADE)	15.18	6.00	6.88	2.4	26.56			57.10	HR	40
MIL	T50GM005	TRK,HWY,4X4 SUBURBAN, 8600 GVW	1.80	0.53	3.22	0.9	1.82	0.21	0.03	8.50	HR	60
MIL	T60KI002	TRK,WTR,OFF-HWY, 6000GAL,CAT621E	17.19	8.05	9.74	3.1	17.48	5.12	0.77	61.46	HR	40
MIL	W35XX009	ELEC DRIVE,WELDER,300 AMP,SKID	0.34	0.09	0.54	0.2	0.25			1.43	HR	1030
MIL	XMIXX020	Small Tools	0.46	0.17	0.13	0.0	0.57			1.39	HR	2010

FREEZE WALL O&M COSTS

1. GENERAL

freezeWALL, Inc. submitted Annual O&M costs as follows:

Operating labor (OL)	$153,000
Maintenance (M)	$ 66,000
Electric Power (EP)	$240,000
Total:	$459,000

The OL was basically 1 FTE, however, in talking with Paul Valcich of WHC, he said that would not work at Hanford. Based on current practices with the groundwater pump-n-treat systems, which, would be "similar" to the freeze system, Mr. Valcich stated that 2 FTE operators would be required per shift, as well as Supervision. For M, Mr. Valcich also stated that 2 FTE craft personnel would be need, as well as Supervision and Safety.

2. ESTIMATE FREEZE WALL O&M COSTS

Assumptions: 1 FTE = $150,000, Only day shift operation - no freezing during off shifts.

OL: 2 FTE operators + 0.25 FTE Supervision and 0.25 FTE Safety = 2.5 FTEs
2.5 FTE x $150,000 = $375,000

M: 2 FTE craft workers, but only needed 1/2 time, use 1.5 FTEs
1.5 FTE x $150,000 = $225,000 + $25,000 (materials/supplies) = $250,000

EP: $240,000 based on $0.03 Kw/Hr, use $0.035 Kw/Hr = $280,000

Annual costs:

OL =	$375,000
M =	$250,000
EP =	$280,000
Total:	$905,000

N-Springs ERA Proposal document used 10 years and a 10% discount rate for comparing alternatives. This computes to a 6.14457 factor.

Therefore, the Present Worth for the freeze wall option would equal:

$905,000 x 6.14457 = $5,560,835

USE: PW O&M = $5,560,000

N-SPRINGS ERA ALTERNATIVES

Alternative: Sheet pile wall w/ grouted interlocks

Capitol Cost: (installed)

Sheet pile wall, subcontractor installed	$4,263,000
Testing (including engineering)	$25,000
Engineering @ 10%	$426,000
Project Management @ 11%	$469,000
SUB-TOTAL:	$5,183,000
Contingency @ 30%	$1,554,900
TOTAL Capital Cost	$6,737,900

O & M Cost: (annual)

Operating Labor	$0
Maintenance	$0
Electric Power	$0
Annual O & M Cost	$0
Present Worth, Annaul O&M 10 Yrs @ 10%	$0
PRESENT WORTH	**$6,737,900**

NOTE:

Waterloo Groundwater Control Technologies, Inc. and RCI Environmental, Inc., submitted a budget quote of $21/SF for installation of a grouted interlock sheet pile wall. This compares to the government estimate of $30.50/SF. Using the $21/SF quoted cost, the installed cost would equal to $2,940,000, and a Total Present Worth cost of $4,657,000. The $21/SF seems low, especially if a Pile Driving Subcontractor is used.

9413224.1027

HNFD: N-Springs Shtpl Wall w/Grt
Rough budget estimate for sheet
pile wall, 50' deep w/ grouted
interlocks

Designed By:
Estimated By: Clendenon

Prepared By: USACE NPW Cost Engr Branch

Preparation Date: 04/24/94
Effective Date of Pricing: 03/22/94
Est Construction Time: 180 Days

9413224.1028

SUMMARY REPORTS — SUMMARY PAGE

DETAILED ESTIMATE — DETAIL PAGE

BACKUP REPORTS — BACKUP PAGE

* * * END TABLE OF CONTENTS * * *

Sun 24 Apr 1994
Eff. Date 03/22/94

U.S. Army Corps of Engineers - D.O. 94 - Final
PROJECT NSSPWG: HNFD: N-Springs Shtpl Wall w/Grt - Rough budget estimate for sheet
Budget estimate for sheet pile wall w/ grout
** PROJECT OWNER SUMMARY - WastSite (Rounded to 10's) **

	QUANTITY UOM	CONTRACT	S & A	CONTG	TOTAL COST	UNIT COST	NOTES
1 Sheetpile Wall, 50' D, w/ Grout		4,262,940	0	0	4,262,940		
TOTAL HNFD: N-Springs Shtpl Wall w/Grt	140000.00 SF	4,262,940	0	0	4,262,940	30.45	

	QUANTITY UOM	CONTRACT	S & A	CONTG	TOTAL COST	UNIT COST	NOTES
1 Sheetpile Wall, 50' D, w/ Grout							
1-01 Mob, DeMob, & Prepwork		12,100	0	0	12,100		
1-02 Site Work		4,250,840	0	0	4,250,840		
TOTAL Sheetpile Wall, 50' D, w/ Grout		4,262,940	0	0	4,262,940		
TOTAL HNFD: N-Springs Shtpl Wall w/Grt	140000.00 SF	4,262,940	0	0	4,262,940	30.45	

Sun 24 Apr 1994
Eff. Date 03/22/94

U.S. Army Corps of Engineers - D.O. 94 - Final
PROJECT NSSPWG: HNFD: N-Springs Shtpl Wall w/Grt - Rough budget estimate for sheet
Budget estimate for sheet pile wall w/ grout
** PROJECT INDIRECT SUMMARY - WastSite (Rounded to 10's) **

	QUANTITY UOM	DIRECT	FOOH	HOOH	PROF	BOND	B&O TAX	TOTAL COST	UNIT COST
1 Sheetpile Wall, 50' D, w/ Grout		3,220,410	483,060	185,170	311,090	21,000	42,210	4,262,940	
TOTAL HNFD: N-Springs Shtpl Wall w/Grt	140000.00 SF	3,220,410	483,060	185,170	311,090	21,000	42,210	4,262,940	30.45

	QUANTITY UOM	DIRECT	FOOH	HOOH	PROF	BOND	B&O TAX	TOTAL COST	UNIT COST
1 Sheetpile Wall, 50' D, w/ Grout									
1-01 Mob, DeMob, & Prepwork		9,140	1,370	530	880	60	120	12,100	
1-02 Site Work		3,211,270	481,690	184,650	310,210	20,940	42,090	4,250,840	
TOTAL Sheetpile Wall, 50' D, w/ Grout		3,220,410	483,060	185,170	311,090	21,000	42,210	4,262,940	
TOTAL HNFD: N-Springs Shtpl Wall w/Grt	140000.00 SF	3,220,410	483,060	185,170	311,090	21,000	42,210	4,262,940	30.45

	DIRECT	FOOH	HOOH	PROF	BOND	B&O TAX	TOTAL COST	UNIT COST
AA Single 50' Deep, Contractor								
PD Piling Subcontractor	2,465,560	246,560	135,610	227,820	0	0	3,075,540	21.97
Subtotal Subcontract Work	2,465,560	246,560	135,610	227,820	0	0	3,075,540	21.97
Indirect on Subcontracts	3,075,540	461,330	176,840	297,100	20,050	40,310	4,071,170	29.08
Indirect on Own Work	144,870	21,730	8,330	13,990	940	1,900	191,760	1.37
AA Single 50' Deep, Contractor	3,220,410	483,060	185,170	311,090	21,000	42,210	4,262,940	30.45

1-01. Mob, DeMob, & Prepwork	QUANTY UOM CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
1. Sheetpile Wall, 50' D, w/ Grout									
2,800 LF, 50' deep, single sheet pile wall, with grouting at interlocks.									
1-01. Mob, DeMob, & Prepwork									
1-01 01. Mob & Prepwork									
USR AA < > Misc equip allowance	10.00 EA	0.00	0.00 0	0.00 0	75.00 750	0.00 0	0.00 0	75.00 750	75.00
USR AA < > Prepwork allowance	1.00 LS	0.00	0.00 0	2500.00 2,500	50.00 50	107.80 108	0.00 0	2657.80 2,658	2657.80
CIV AA <01505 1401 > Mob, Crane, 25-50 Ton, Mech, Trk Mtd, 100' boom, 100-mi Rad	2.00 EA N/A	0.00	0.00 0	0.00 0	625.00 1,250	0.00 0	0.00 0	625.00 1,250	625.00
CIV AA <01505 6115 > Mob, Dozer, Crawler, 176-225 HP w/blade, Incl Setup, 100-mi Rad	1.00 EA N/A	0.00	0.00 0	0.00 0	700.00 700	0.00 0	0.00 0	700.00 700	700.00
CIV AA <01505 7113 > Mob, Truck, 0-10,000 GVW, w/ 8'x 10' Flat Bed, 100-mi Rad	1.00 EA N/A	0.00	0.00 0	0.00 0	55.00 55	0.00 0	0.00 0	55.00 55	55.00
CIV AA <01505 5202 > Mob, Motor Grader, 126-150 HP, Art. Fr, Pwr Shift, 100-mi Rad	1.00 EA N/A	0.00	0.00 0	0.00 0	475.00 475	0.00 0	0.00 0	475.00 475	475.00
CIV AA <01505 8102 > Mob, Air Comp, 251- 800 CFM, Quiet, Portable, 100-mi Rad	2.00 EA N/A	0.00	0.00 0	0.00 0	125.00 250	0.00 0	0.00 0	125.00 250	125.00
TOTAL Mob & Prepwork			0	2,500	3,530	108	0	6,138	
TOTAL DeMob Allowance			0	0	3,000	0	0	3,000	
TOTAL Mob, DeMob, & Prepwork			0	2,500	6,530	108	0	9,138	

1-02. Site Work	QUANTY	UOM	CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
1-02. Site Work											
1-02 01. Site Prep - Work Platform Assume a work platform will need to be prepared. Platform will be constructed using a D-7 dozer, G-12 grader, and water truck (6K gal). Assume about 15'-20' wide platform, no new fill needed, 5 days to prepare.											
L USR AA <02210 1005 > Rough Grade Small Area w/Dozer Cat D-7, 215 HP. Allow 5 days for dozer to rough grade platform for pile driving and grouting work.	40.00	HR	CODTH	1.00	2.00 80	54.75 2,190	62.82 2,513	0.00 0	0.00 0	117.57 4,703	117.57
L USR AA <02210 2001 > Grade platform	6.00	MSY	COFGA	0.25	8.00 48	219.00 1,314	111.25 668	0.00 0	0.00 0	330.25 1,982	330.25
USR AA <02223 1001 > Compaction/Dust control Water, from river	40.00	HR	COFWK	1.00	1.75 70	49.33 1,973	67.15 2,686	0.00 0	0.00 0	116.47 4,659	116.47
TOTAL Site Prep - Work Platform	2800.00	LF			198	5,477	5,866	0	0	11,343	4.05
1-02 02. Sheetpile wall installation This covers cost for a 50' deep, 2,800 LF sheet pile wall, assume using 38 psf sheet pile, placed by vibratory driver. By placing wall close to river, it is assumed the wall will miss the large cobble/boulder layer associated with the Hanford formation. Assume sheet piling driven by subcontractor.											
B USR PD <02411 1004 > Steel Sheeting, use 38 psf 140,000 SF @ 38 psf = 2,660 Ton Use: $700/ton for material and 15 ton/day production rate (20 ton/day is standard). Using slower rate to account for possible problems with large cobbles or boulders.	2660.00	TON	CPIDV	2.00	4.00 10,640	110.03 365,082	62.27 206,630	754.60 2,503,826	0.00 0	926.90 3,075,538	1156.22
TOTAL Sheetpile wall installation	140000	SF			10,640	365,082	206,630	2,503,826	0	3,075,538	21.97
1-02 03. Grouting of sheet pile wall Grouting will be placed in inter-locks of sheet pile wall, with attapulgite-cement grout. Assumed grouting depth will be 50'.											
B MIL AA <03620 2203 > Nonshrink,Nonmtl Grout Allowance for grouting interlock	75500	LF	ACMAG	250.00	0.02 1,208	0.43 32,586	0.05 3,986	0.27 20,347	0.00 0	0.75 56,919	0.75
USR AA <03711 1001 > Air blasting/cleaning interlock Allowance for cleaning interlocks.	75500	LF	ACMAF	250.00	0.02 1,204	0.47 35,470	0.05 3,511	0.38 28,486	0.00 0	0.89 67,467	0.89

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1-02. Site Work	QUANTY UOM	CREW ID	OUTPUT	MHRS	LABR	EQUIP	MAT	OTHER	TOTAL COST	UNIT COST
TOTAL Grouting of sheet pile wall	75500 LF			2,492	68,056	7,497	48,833	0	124,386	1.65
TOTAL Site Work				13,330	438,615	219,993	2,552,660	0	3,211,268	
TOTAL Sheetpile Wall, 50' D, w/ Grout				13,330	441,115	226,523	2,552,767	0	3,220,406	
TOTAL HNFD: N-Springs Shtpl Wall w/Grt	1.00 EA			13,330	441,115	226,523	2,552,767	0	3,220,406	3220405.52

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Sun 24 Apr 1994
Eff. Date 03/22/94

PROJECT NSSPWG: U.S. Army Corps of Engineers - D.O. 94 - Final
HNFD: N-Springs Shtpl Wall w/Grt - Rough budget estimate for sheet
Budget estimate for sheet pile wall w/ grout
** CREW BACKUP **

TIME 11:54:58

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
	ACMAF	2 B-cemtfinr + 1-air Compressor, 375 Cfm				PROD = 100%			CREW HOURS =	302
MIL	A15XX010	E AIR COMPR, 375 CFM, 100 PSI	1.00	HR	11.21			1.00	11.21	11.21
MIL	B-CEMTFINRF	Cement Finishers	0.25	HR	28.95	0.25	7.24			7.24
MIL	B-CEMTFINRL	Cement Finishers	2.00	HR	28.45	2.00	56.90			56.90
MIL	B-LABORER L	Laborer (Semi-Skilled)	1.00	HR	25.64	1.00	25.64			25.64
MIL	B-EQOPRLT L	Eq Oper, Light	1.00	HR	27.68	1.00	27.68			27.68
MIL	A20XX002	E AIR HOSE, 1.0", 50', HARDROCK	1.00	HR	0.42			1.00	0.42	0.42
	TOTAL					4.25	117.46	2.00	11.63	129.09
	ACMAG	2 B-laborer + Grouting Equipment, 5cy/Hr				PROD = 100%			CREW HOURS =	302
MIL	B-CEMTFINRL	Cement Finishers	1.00	HR	28.45	1.00	28.45			28.45
MIL	B-LABORER F	Laborer (Semi-Skilled)	1.00	HR	26.14	1.00	26.14			26.14
MIL	B-LABORER L	Laborer (Semi-Skilled)	1.00	HR	25.64	1.00	25.64			25.64
MIL	B-EQOPRLT L	Eq Oper, Light	1.00	HR	27.68	1.00	27.68			27.68
MIL	XMIXX020	E Small Tools	0.18	HR	1.39			0.18	0.25	0.25
MIL	P45CG003	E PMP,GRT,PLANT,AIR,1-20GPM,100PS	1.00	HR	3.66			1.00	3.66	3.66
MIL	A15XX009	E AIR COMPR, 250 CFM, 100 PSI	1.00	HR	8.86			1.00	8.86	8.86
MIL	A20XX002	E AIR HOSE, 1.0", 50', HARDROCK	1.00	HR	0.42			1.00	0.42	0.42
	TOTAL					4.00	107.91	3.18	13.19	121.10
	CODTH	1 B-eqoprmed + 1 Dozer, Cat D-7H, 215 Hp+Laborer				PROD = 100%			CREW HOURS =	40
MIL	B-LABORER L	Laborer (Semi-Skilled)	1.00	HR	25.64	1.00	25.64			25.64
MIL	B-EQOPRMEDF	Eq Oper, Medium	1.00	HR	29.11	1.00	29.11			29.11
MIL	T10CA013	E BLADE, UNIVERSAL,HYDR,FOR D7	1.00	HR	5.72			1.00	5.72	5.72
MIL	T15CA013	E DOZER,CWLR,D-7H,PS,(ADD BLADE)	1.00	HR	57.10			1.00	57.10	57.10
	TOTAL					2.00	54.75	2.00	62.82	117.57
	COFGA	1 B-eqoprmed + 1 Grader, Cat 12g, 135 Hp				PROD = 100%			CREW HOURS =	24
MIL	B-LABORER L	Laborer (Semi-Skilled)	1.00	HR	25.64	1.00	25.64			25.64
MIL	B-EQOPRMEDF	Eq Oper, Medium	1.00	HR	29.11	1.00	29.11			29.11
MIL	G15CA003	E GRADER,MOTOR,CAT12-G, ARTIC	1.00	HR	27.81			1.00	27.81	27.81
	TOTAL					2.00	54.75	1.00	27.81	82.56
	COFWK	1 B-trkdvrhvl+ 1 Water Wagon,6000 Gal + 6" Pump				PROD = 100%			CREW HOURS =	40
MIL	B-EQOPRLT F	Eq Oper, Light	0.25	HR	28.18	0.25	7.05			7.05
MIL	B-TRKDVRHVL	Truck Drivers, Heavy	1.00	HR	28.44	1.00	28.44			28.44
MIL	B-EQOPRLT L	Eq Oper, Light	0.50	HR	27.68	0.50	13.84			13.84
MIL	P55GR004	E PUMP,WATER,SUB,6",1950GPM/40'HD	1.00	HR	5.68			1.00	5.68	5.68
MIL	T60KI002	E TRK,WTR,OFF-HWY, 6000GAL,CAT621	1.00	HR	61.46			1.00	61.46	61.46
	TOTAL					1.75	49.33	2.00	67.15	116.47
	CPIDV	5 B-piledrvr + 1 Vibratory Pile Hammer/40T Crane				PROD = 100%			CREW HOURS =	1330
MIL	B-EQOPRCRNL	Eq Oper, Crane/Shovl	2.00	HR	29.37	2.00	58.74			58.74
MIL	B-EQOPROILL	Eq Oper, Oilers	1.00	HR	26.68	1.00	26.68			26.68
MIL	B-PILEDRVRF	Pile Drivers	1.00	HR	29.66	1.00	29.66			29.66
MIL	B-PILEDRVRA	Pile Drivers	2.00	HR	23.33	2.00	46.66			46.66

SRC	ITEM ID	DESCRIPTION	NO.	UOM	RATE	**** LABOR **** HOURS	COST	**** EQUIP **** HOURS	COST	TOTAL COST
MIL	B-PILEDRVRL	Pile Drivers	2.00	HR	29.16	2.00	58.32			58.32
MIL	C80PH004	E CRANE,HYD,TRKMTD, 40T W/106'BOO	1.00	HR	51.28			1.00	51.28	51.28
MIL	XMIXX020	E Small Tools	1.35	HR	1.39			1.35	1.88	1.88
MIL	P30MK003	E PILE HAMMER,VIB,MAX DRIVE 116TO	1.00	HR	71.39			1.00	71.39	71.39
	TOTAL					8.00	220.06	3.35	124.55	344.60

** LABOR BACKUP **

SRC LABOR ID	DESCRIPTION	BASE	OVERTM	TXS/INS	FRNG	TRVL	RATE	UOM	UPDATE	**** TOTAL **** DEFAULT	HOURS
MIL B-CEMTFINR	Cement Finishers	28.45	0.0%	0.0%	0.00	0.00	28.45	HR	03/15/94	13.98	982
MIL B-EQOPRCRN	Equip. Operators, Crane/Shovel	29.37	0.0%	0.0%	0.00	0.00	29.37	HR	03/15/94	21.20	2660
MIL B-EQOPRLT	Equip. Operators, Light	27.68	0.0%	0.0%	0.00	0.00	27.68	HR	03/15/94	17.02	634
MIL B-EQOPRMED	Equip. Operators, Medium	28.61	0.0%	0.0%	0.00	0.00	28.61	HR	03/15/94	17.15	64
MIL B-EQOPROIL	Equip. Operators, Oilers	26.68	0.0%	0.0%	0.00	0.00	26.68	HR	03/15/94	11.00	1330
MIL B-LABORER	Laborers, (Semi-Skilled)	25.64	0.0%	0.0%	0.00	0.00	25.64	HR	03/15/94	12.86	970
MIL B-PILEDRVR	Pile Drivers	29.16	0.0%	0.0%	0.00	0.00	29.16	HR	03/15/94	23.05	6650
MIL B-TRKDVRHV	Truck Drivers, Heavy	28.44	0.0%	0.0%	0.00	0.00	28.44	HR	03/15/94	10.49	40

SRC	EQUIP ID	DESCRIPTION	DEPR	CAPT	FUEL	FOG	EQ REP	TR WR	TR REP	TOTAL	UOM	** TOTAL ** HOURS
MIL	A15XX009	AIR COMPR, 250 CFM, 100 PSI	2.07	0.83	2.80	0.7	2.33	0.04	0.01	8.86	HR	302
MIL	A15XX010	AIR COMPR, 375 CFM, 100 PSI	2.67	1.10	3.31	0.9	3.03	0.16	0.02	11.21	HR	302
MIL	A20XX002	AIR HOSE, 1", 50',HARDROCK	0.14	0.02			0.25			0.42	HR	604
MIL	C80PH004	CRANE,HYD,TRK MTD,40T W/106'BOOM	17.04	8.72	6.64	1.7	15.98	1.02	0.15	51.28	HR	1330
MIL	G15CA003	GRADER,MOTOR,CAT12-G, ARTIC	8.89	4.25	3.65	1.2	9.10	0.58	0.09	27.81	HR	24
MIL	P30MK003	PILE HAMMER,VIB,MAX DRIVE 116TON	18.96	5.91	10.33	3.3	32.89			71.39	HR	1330
MIL	P45CG003	PMP,GRT,PLANT,AIR,1-20GPM,100PSI	1.38	0.37		0.1	1.77			3.66	HR	302
MIL	P55GR004	PUMP,WATER,SUB,6",1950GPM/40'HD	0.95	0.38	2.43	1.0	0.84			5.68	HR	40
MIL	T10CA013	BLADE, UNIVERSAL,HYDR,FOR D7	2.31	0.82		0.0	2.51			5.72	HR	40
MIL	T15CA013	DOZER,CWLR,D-7H,PS,(ADD BLADE)	15.18	6.00	6.88	2.4	26.56			57.10	HR	40
MIL	T60KI002	TRK,WTR,OFF-HWY, 6000GAL,CAT621E	17.19	8.05	9.74	3.1	17.48	5.12	0.77	61.46	HR	40
MIL	XMIXX020	Small Tools	0.46	0.17	0.13	0.0	0.57			1.39	HR	1850

CORRESPONDENCE DISTRIBUTION COVERSHEET

Author	Addressee	Correspondence No.
Patrick W. Willison, RL	Douglas R. Sherwood, EPA Roger F. Stanley, Ecology	Incoming: 9401799

Subject: N Springs Expedited Response Action (ERA)

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